Research Article

Microwave-Assisted Synthesis and Characterization of Certain Oximes, Hydrazones, and Olefins Derived from β -Keto Sulfones

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A new series of β -keto sulfone derivatives containing oximes **4a–e**, hydrazones **5a, b**, and chalcones **7a–d** were prepared using microwave irradiation (MWI) by the reaction of β -keto sulfones **3** with hydroxyl amine, hydrazines, and aromatic aldehydes, respectively. The comparative study between microwave irradiation and conventional syntheses showed that MWI is effective in the synthesis of the title compounds through shortening of the reaction time and improvements in their yields. The structures of the synthesized compounds were established under the basis of their spectral data and X-ray single crystal analysis of compound **5a**. The crystal of **5a** belongs to triclinic space group *P*-1, with $a = 5.7735$ (2) Å, $b = 9.3224$ (3) Å, $c = 13.1696$ (5) Å, $\alpha = 76.411$ (1)°, $\beta = 89.571$ (1)°, $\gamma = 79.9380$ (9)°, $Z = 2$, $V = 677.97$ (4) Å³, $D_c = 1.513$ Mg m⁻³, $\mu = 0.44$ mm⁻¹, $F(000) = 320$, $R = 0.026$, and $wR = 0.070$ for 2690 observed reflections with $I > 2\sigma(I)$.

1. Introduction

Over the past few years, sulfone derivatives have attracted considerable attention due to their broad spectrum of biological activities [1, 2] and for their great importance in organic chemistry [3, 4]. Among the derivatives of sulfones, special attention has been drawn to the construction and reactivity of β -keto sulfones [5–9]. Some β -keto sulfones have been reported as effective antimicrobial agents against *S. aureus* and *C. tropicalis* [10]. Moreover, β -keto sulfones have been reported as selective inhibitors of 11 β -hydroxysteroid dehydrogenase type I [11, 12]. β -Keto sulfones are key starting materials in the synthesis of several biologically active compounds; for example, β -keto sulfones was used in the preparation of fused pyrimidine derivatives as potent Aurora-A kinase inhibitors [13] and they were used also in the preparation of novel celecoxib analogs as potent anti-inflammatory agents [14]. Moreover, oxime derivatives showed a wide range of biological activity such as antifungal [15] and anticonvulsant [16] activities in addition to their antibacterial activity against multidrug resistant bacteria [17]. Hydrazone function is an important part in compounds with antibacterial

activity [18] and with activity against methicillin-resistant *Staphylococcus aureus* [19]. Olefin derivatives have exhibited antibacterial activity [1] in addition to their antiparasitic activity when combined with sulfone function [2].

In the light of previous data and in continuation of our interests in synthetic organic chemistry [14, 20–22], we report herein the microwave-assisted synthesis of some new oximes **4a–e**, hydrazones **5a, b**, and olefins **7a–d** derived from β -keto sulfones derivatives.

2. Experimental

2.1. Chemistry

2.1.1. General. Melting points were determined on a Gallenkamp melting point apparatus and are uncorrected. Infrared (IR) spectra were recorded as KBr disks using the Perkin Elmer FT-IR Spectrum BX apparatus. NMR spectra were scanned in DMSO-*d*₆ or CDCl₃ on a Bruker NMR spectrometer operating at 500 MHz for ¹H and 125 MHz for ¹³C. Chemical shifts are expressed in δ -values (ppm)

relative to TMS as an internal standard. Coupling constants (J) are expressed in Hz. D_2O was added to confirm the exchangeable protons. The mass spectra were performed using a Varian MAT CH-5 spectrometer (70 eV) or on an Agilent Triple Quadrupole 6410 QQQ LC/MS equipped with an ESI (electrospray ionization) source. The microwave irradiations were carried out in an Explorer-48 microwave reactor from CEM, USA.

2.1.2. Synthesis of 1-Aryl-2-arylsulfonyl Ethanones 3. These compounds were prepared according to the reported method [23].

2.1.3. Synthesis of 1-(Aryl)-2-(arylsulfonyl)ethanone

Oximes **4a-e**

MWI Synthesis. A mixture of the appropriate sulfone **3** (1 mmol) and hydroxylamine hydrochloride (0.11 g, 1.5 mmol) and anhydrous sodium acetate (0.12 g, 1.5 mmol) in ethanol (5 mL) was added to a closed vessel in a microwave reactor. The closed vessel was irradiated with microwaves at 100 W and 90°C, with 200 psi maximum pressure for 2 min (holding time). The vessel was cooled and the solid that formed was collected by filtration and washed with water, dried, and finally recrystallized from EtOH to afford compounds **4a-e**, respectively, in 80–88% yields.

Conventional Synthesis. A mixture of the appropriate sulfone **3** (10 mmol), hydroxylamine hydrochloride (1.1 g, 15 mmol), and anhydrous sodium acetate (1.2 g, 15 mmol) in ethanol (50 mL) was refluxed for 1 h and then left to cool. The reaction mixture was poured into cold water and the solid product was filtered off, washed with water, and dried. Recrystallized from EtOH afforded **4a-e** in 54–70% yields.

(1)-[4-(Methoxyphenyl)-2-(phenylsulfonyl)ethanone Oxime (4a). Yield (75%); m.p. 148–150°C; IR ν 3250 (OH) cm^{-1} ; 1H NMR ($CDCl_3$) δ 3.79 (s, 3H, OCH_3), 4.65 (s, 2, CH_2), 6.80 (d, J = 9.0 Hz, 2H, ArH), 7.38–7.42 (m, 2H, ArHs), 7.51–7.54 (m, 3H, ArH), 7.77 (d, J = 8.0 Hz, 2H, ArH), 11.92 (s, D_2O exchangeable, 1H, OH); ^{13}C NMR ($CDCl_3$) δ 52.70 ($-OCH_3$), 55.38 ($-CH_2$), 112.10, 114.09, 125.89, 127.33, 128.19, 128.47, 128.86, 128.94, 131.32, 133.99, 139.47, 147.53; MS (EI) m/z 305 $[M]^+$.

(2) 1-(4-Chlorophenyl)-2-(phenylsulfonyl)ethanone Oxime (4b). Yield (88%); m.p. 153–155°C; IR ν 3270 (OH) cm^{-1} ; 1H NMR ($CDCl_3$) δ 4.27 (s, 2, CH_2), 7.26 (d, J = 8.5 Hz, 2H, ArH), 7.40–7.43 (m, 2H, ArH), 7.52–7.56 (m, 3H, ArH), 7.77 (d, J = 7.5 Hz, 2H, ArH), 11.91 (s, D_2O exchangeable, 1H, OH); ^{13}C NMR ($CDCl_3$) δ 52.46 ($-CH_2$), 127.95, 128.45, 128.57, 128.86, 128.95, 129.17, 132.00, 133.99, 136.19, 139.34, 147.05; MS (EI) m/z 309 $[M]^+$.

(3) 1-(Naphthalen-2-yl)-2-(phenylsulfonyl)ethanone Oxime (4c). Yield (80%); m.p. 138–140°C; IR ν 3248–2942 (OH) cm^{-1} ; 1H NMR ($DSMO-d_6$) δ 5.09 (s, 2H, CH_2), 7.53–7.56 (m, 4H,

ArH), 7.64–7.67 (m, 1H, ArH), 7.79–7.80 (m, 2H, ArH), 7.83–7.93 (m, 4H, ArH), 8.14 (s, 1H, ArH), 11.91 (s, D_2O exchangeable, 1H, OH); ^{13}C NMR ($DSMO-d_6$) δ 51.23, 123.34, 126.44, 126.55, 126.74, 127.44, 127.70, 127.82, 128.36, 128.78, 129.01, 131.87, 132.51, 133.01, 133.83, 139.72, 145.50; MS (ESI) m/z 325.1 $[M]^+$.

(4) 1-(4-Tolyl)-2-tosylethanone Oxime (4d). Yield (83%); m.p. 168–170°C; IR ν 3069 (OH) cm^{-1} ; 1H NMR ($CDCl_3$) δ 2.29 (s, 3H, CH_3), 2.31 (s, 3H, CH_3), 4.63 (s, 2H, CH_2), 7.09 (d, J = 8.0 Hz, 2H, ArH), 7.15 (d, J = 8.0 Hz, 2H, ArH), 7.43 (d, J = 8.5 Hz, 2H, ArH), 7.62 (d, J = 8.5 Hz, 2H, ArH), 11.90 (s, D_2O exchangeable, 1H, OH); ^{13}C NMR ($CDCl_3$) δ 21.33 ($-CH_3$), 21.46 ($-CH_3$), 52.86 ($-CH_2$), 126.65, 128.48, 128.69, 128.94, 129.35, 129.44, 129.72, 129.87, 130.63, 136.57, 140.30, 144.89, 148.10; MS (EI) m/z : 303 $[M]^+$.

(5) 1-(Naphthalen-2-yl)-2-tosylethanone Oxime (4e). Yield (84%); m.p. 158–160°C; IR ν 3200 (OH) cm^{-1} ; 1H NMR ($CDCl_3$) δ 2.21 (s, 1H, CH_3), 4.78 (s, 2, CH_2), 7.08 (d, J = 8.5 Hz, 2H, ArH), 7.42–7.45 (m, 2H, ArH), 7.63 (d, J = 8.5 Hz, 2H, ArH), 7.70–7.75 (m, 4H, ArH), 7.88 (s, 1H, ArH), 11.91 (s, D_2O exchangeable, 1H, OH); ^{13}C NMR ($CDCl_3$) δ 21.51 ($-CH_3$), 52.67 ($-CH_2$), 123.25, 126.54, 127.16, 127.27, 127.59, 128.35, 128.51, 128.76, 129.46, 130.81, 132.88, 133.86, 136.51, 144.98, 148.08; MS (EI) m/z 339 $[M]^+$.

2.1.4. Synthesis of Hydrazones **5a, b**

MWI Synthesis. A mixture of the appropriate sulfone **3** (1 mmol) and hydrazine hydrate (99%) or phenyl hydrazine (1 mmol) in ethanol (5 mL), acetic acid (0.5 mL) was added to a closed vessel in a microwave reactor. The closed vessel was irradiated with microwave at 100 W and 90°C, with 200 psi maximum pressure for 30 sec (holding time). The vessel was cooled and the solid that formed was collected by filtration and washed with ethanol, dried, and finally recrystallized from EtOH to afford compounds **5a, b**, respectively, in 86% and 94% yield, respectively.

Conventional Synthesis. A mixture of the appropriate sulfone **3** (1 mmol) and hydrazine hydrate or phenyl hydrazine (1 mmol) in ethanol (25 mL), acetic acid (0.5 mL) was added. The reaction mixture was stirred for 6 h. The precipitated product was filtered off, washed with ethanol, dried and finally recrystallization from ethanol afforded the corresponding hydrazones **5a, b**, in 69% and 65% yield, respectively.

(1) (Z)-[1-(4-Chlorophenyl)-2-(phenylsulfonyl)ethylidene]hydrazine (5a). Yield (86%); m.p. 151–153°C; IR ν 3150–3400 (NH_2) cm^{-1} ; 1H NMR ($DSMO-d_6$) δ 4.84 (s, 2H, CH_2), 7.22–7.35 (m, 3H, ArH), 7.55–7.68 (m, 4H, ArH), 7.70 (s, D_2O exchangeable, 1H, NH_2), 7.86–7.95 (m, 2H, ArH); ^{13}C NMR ($DSMO-d_6$) δ 51.14, 126.75, 127.73, 127.96, 129.14, 129.81, 131.44, 133.97; MS (ESI) m/z 308.8 $[M]^+$.

(3) 1-(1-(Naphthalen-2-yl)-2-(phenylsulfonyl)ethylidene)-2-phenylhydrazine (5b). Yield (94%); m.p. 140–142°C; IR ν

3340 (NH) cm^{-1} ; ^1H NMR ($\text{DSMO}-d_6$) δ 5.31 (s, 2H, CH_2), 6.83–6.86 (m, 1H, ArH), 7.19–7.21 (m, 2H, ArH), 7.26–7.28 (m, 2H, ArH), 7.48–7.49 (m, 5H, ArH), 7.80–7.93 (m, 5H, ArH), 8.01 (s, 1H, ArH), 8.05–8.07 (m, 1H, ArH), 9.86 (s, D_2O exchangeable, 1H, NH); ^{13}C NMR ($\text{DSMO}-d_6$) δ 51.63, 113.06, 119.98, 123.48, 124.84, 126.01, 126.13, 127.29, 127.36, 128.16, 128.37, 128.88, 129.00, 129.26, 132.24, 132.74, 133.89, 134.93, 139.36, 144.64; MS (ESI) m/z 400.1 $[\text{M}]^+$.

2.1.5. Synthesis of Olefins 7a–d

MWI Synthesis. To a mixture of the sulfone **3** (1 mmol) and the appropriate aldehyde (1 mmol) in ethanol (30 mL), piperidine (0.5 mL) was added to a closed vessel in a microwave reactor. The closed vessel was irradiated with microwave at 100 W and 90°C, with 200 psi maximum pressure for 3 min (holding time). The vessel was then left to cool. The precipitated product was filtered off and purified by recrystallization from ethanol to afford the corresponding olefins **7a–d** in 77%–85% yields.

Conventional Synthesis. To a mixture of the sulfone **3** (1 mmol) and the appropriate aldehyde (1 mmol) in ethanol (30 mL), piperidine (0.5 mL) was added. The reaction mixture was refluxed for 5 h and then left to cool. The precipitated product was filtered off and purified by recrystallization from ethanol to afford **7a–d** in 42%–62% yields.

(1) (*E*)-3-(4-Chlorophenyl)-1-phenyl-2-tosylprop-2-en-1-one (**7a**). Yield (62%); m.p. 198–200°C; IR ν 1676 ($\text{C}=\text{O}$) cm^{-1} ; ^1H NMR (CDCl_3) δ 2.34 (s, 3H, CH_3), 6.72–7.10 (m, 5H, ArH), 7.22–7.93 (m, 8H, ArH), 8.42 (s, 1H, =CH); ^{13}C NMR (CDCl_3) δ 21.71 ($-\text{CH}_3$), 127.76, 128.00, 128.63, 128.73, 128.84, 129.18, 129.34, 129.47, 129.84, 130.00, 130.91, 134.31, 135.81, 145.36, 190.83; MS (EI) m/z 396 $[\text{M}]^+$.

(2) (*E*)-1,3-Bis(4-methoxyphenyl)-2-tosylprop-2-en-1-one (**7b**). Yield (42%); m.p. 188–190°C; IR ν 1667 ($\text{C}=\text{O}$) cm^{-1} ; ^1H NMR ($\text{DSMO}-d_6$) δ 2.41 (s, 3H, $-\text{CH}_3$), 3.82 (s, 3H, OCH_3), 3.89 (s, 3H, $-\text{OCH}_3$), 6.88 (d, J = 8.5 Hz, 2H, ArH), 7.14 (d, J = 8.5 Hz, 2H, ArH), 7.32 (d, J = 9.0 Hz, 2H, ArH), 7.71 (d, J = 8.0 Hz, 2H, ArH), 7.88 (d, J = 8.5 Hz, 2H, ArHs), 7.91 (d, J = 9.0 Hz, 2H, ArH), 8.33 (s, 1H, =CH); MS (EI) m/z 422 $[\text{M}]^+$.

(3) (*E*)-3-(4-Chlorophenyl)-1-(4-fluorophenyl)-2-tosylprop-2-en-1-one (**7c**). Yield (55%); m.p. 218–220°C; IR ν 1673 ($\text{C}=\text{O}$) cm^{-1} ; ^1H NMR (CDCl_3) δ 2.38 (s, 3H, CH_3), 7.07–7.12 (m, 3H, ArH), 7.26–7.28 (m, 2H, ArH), 7.67–7.69 (m, 3H, ArH), 7.75–7.77 (m, 2H, ArH), 7.91–7.95 (m, 2H, ArH), 8.60 (s, 1H, =CH); ^{13}C NMR (CDCl_3) δ 20.69 ($-\text{CH}_3$), 115.32, 127.53, 127.69, 128.29, 128.45, 128.86, 129.89, 130.23, 131.18, 131.26, 131.61, 131.69, 133.71, 134.67, 138.36, 139.26, 139.94, 144.09, 144.46, 189.81; MS (EI) m/z 414 $[\text{M}]^+$.

(4) (*E*)-1,3-Bis(4-chlorophenyl)-2-tosylprop-2-en-1-one (**7d**). Yield (57%); m.p. 235–237°C; IR ν 1674 ($\text{C}=\text{O}$) cm^{-1} ; ^1H NMR (CDCl_3) δ 2.37 (s, 3H, CH_3), 7.27 (d, J = 8.5 Hz, 2H, ArHs), 7.40 (d, J = 8.5 Hz, 2H, ArH), 7.45 (d, J = 8.5 Hz, 2H, ArH), 7.67 (d, J = 8.5 Hz, 2H, ArH), 7.78 (d, J = 8.5 Hz, 2H,

ArH), 7.84 (d, J = 8.5 Hz, 2H, ArH), 8.50 (s, 1H, =CH); ^{13}C NMR (CDCl_3) δ 20.70 ($-\text{CH}_3$), 127.54, 128.19, 128.45, 129.76, 129.89, 133.09, 133.71, 139.95, 189.80; MS (EI) m/z 433 $[\text{M}]^+$.

2.2. X-Ray Crystallography

2.2.1. General. Single crystals were obtained by slow evaporation from ethanol. A good crystal with a suitable size was selected for X-ray diffraction analysis. Data were collected on a Bruker D8 Venture area diffractometer equipped with graphite monochromatic $\text{MoK}\alpha$ radiation (λ = 0.71073 Å) at 100 K. Cell refinement and data reduction were done by Bruker SAINT (Bruker, 2009); program used to solve structure and refine structure is SHELXS-97 [24]. The final refinement was performed by full-matrix least-squares techniques with anisotropic thermal data for nonhydrogen atoms on F^2 . All the hydrogen atoms were placed in calculated positions and constrained to ride on their parent atoms. Multiscan absorption correction was applied by use of SADABS software (Bruker, 2009). The crystal structure of compound **5a** contains one molecule in the asymmetric unit.

2.2.2. Crystal Data of 5a. Molecular formula $\text{C}_{14}\text{H}_{13}\text{ClN}_2\text{O}_2\text{S}$, Formula weight: 308.77, Triclinic, *P*-1, a = 5.7735 (2) Å, b = 9.3224 (3) Å, c = 13.1696 (5) Å, α = 76.411 (1)°, β = 89.571 (1)°, γ = 79.9380 (9)°, V = 677.97 (4) Å³, and D_{calc} = 1.513 Mg m^{-3} . A total of 20423 reflections were measured, of which 2771 were independent. R_{int} = 0.021, Dataset (h; k; l) = −7, 7; −11, 11; −16, 16. Refinement of F^2 , against all reflections, led to R [$F^2 > 2\sigma(F^2)$] = 0.026, $wR(F^2)$ = 0.178, S = 1.00. The labeled displacement ellipsoid plot of this molecule showing the three intramolecular interactions is shown in Figure 1.

3. Results and Discussion

3.1. Chemistry. 1-Aryl-2-(arylsulfonyl)ethanones **3** were synthesized by the reaction of bromo-1-arylethanones **1** with sodium (aryl)sulfinate **2** (Scheme 1) according to the reported method [23]. Sulfones **3** were reacted with hydroxyl amine in the presence of sodium acetate to afford oximes **4a–e**, respectively (Scheme 1). The latter reaction was performed in ethanol under microwave irradiation (100 W, 90°C) for 2 min to give oximes **4a–e** in good yield (80–88%). However, oximes **4a–e** were also prepared conventionally in refluxing ethanol for 1 h in 54–70% yield.

The IR spectra of oximes **4a–e** showed the appearance of OH absorption band in 3069–3270 cm^{-1} region, whereas their ^1H NMR revealed the singlet signal of methylene protons in the region δ 4.27–5.09. Moreover, ^{13}C NMR of compounds **4a–e** showed the signal of methylene carbon in the region δ 51.23–55.38 in addition to the signal of SP^2 carbon of $-\text{C}=\text{N}-$ group in the region δ 145.50–148.10.

Furthermore, the reaction of sulfones **3** with hydrazine or phenylhydrazine in ethanol at 90°C under microwave irradiation with power 100 W for 30 sec gave hydrazones **5a**, **b** in 86% and 94% yield, respectively (Scheme 1). However, the conventional synthesis of hydrazones **5a**, **b** at ambient temperature afforded hydrazones **5a**, **b** in lower yields.

SCHEME 1: Synthesis of oximes **4a–e** and hydrazones **5a, b**. Reagents and conditions: (i) $\text{NH}_2\text{-OH}/\text{AcONa}/\text{EtOH}$, MWI, 100 W, 90°C , 2 min, 80–88% yield. (ii) $\text{NH}_2\text{-NH}_2$ (99%) or $\text{NH}_2\text{-NHPh}/\text{EtOH}/\text{AcOH}$ (catalytic amount), MWI, 100 W, 90°C , 30 sec, 86% and 94% yield, respectively.

SCHEME 2: Synthesis of olefins **7a–d**. (iii) Ar-CHO **6a, b**/EtOH/piperidine (catalytic amount)/MWI, 100 W, 90°C , 3 min, 77–85% yield.

The ^1H NMR of **5a** showed the D_2O exchangeable singlet signal of NH_2 at δ 7.70 whereas ^1H NMR of phenyl hydrazone **5b** exhibited the signal of the NH group at δ 9.86. The X-ray single crystal analysis of compound **5a** gave the relative configuration for the 3D structure (Figure 1) [25].

Next, the reaction of sulfones **3** with 4-chlorobenzaldehyde **6a** or 4-anisaldehyde **6b**, in the presence of piperidine under microwave irradiation (100 W, 90°C) for 3 min, afforded the corresponding olefins **7a–d**, respectively, in 77–85% yields (Scheme 2). The time requested to complete the latter reaction in conventional synthesis is 5 h with moderate yields. The structure of the latter compounds was confirmed on the basis of their spectral data; for example, their IR spectra revealed the absorption band of carbonyl function in

the region $1665\text{--}1676\text{ cm}^{-1}$ while their ^1H NMR exhibited the signal of $-\text{CH}=\text{}$ proton in the region δ 8.33–8.60.

3.2. Interpretation of the X-Ray Structure. The asymmetric unit of compound **5a**, $\text{C}_{14}\text{H}_{13}\text{ClN}_2\text{O}_2\text{S}$, contains one molecule with *Z* configuration about the $\text{C7}=\text{N1}$ double bond (Figure 1). The *Z* configuration of **5a** is stabilized with intramolecular hydrogen $\text{N2-H1}\cdots\text{O2}$ (Table 2). The single bond N1-N2 is clearly characterized by the distance of 1.3496 (16) Å. The double bond of $\text{C7}=\text{N1}$ is characterized by the distance of 1.2933 (16) Å. The dihedral angle between the two benzene rings is $45.63 (5)^\circ$. The packing in the crystal structure is stabilized by intermolecular interactions $\text{N2-H2}\cdots\text{N1}$ and $\text{N2-H1}\cdots\text{O1}$ which links the molecules into

TABLE 1: Selected geometric parameters ($\text{\AA}$, $^\circ$) of **5a**.

Bond distance			
Cl1–C3	1.7437 (13)	S1–C9	1.7650 (12)
S1–O1	1.4425 (10)	N1–N2	1.3496 (16)
S1–O2	1.4459 (9)	N1–C7	1.2933 (16)
S1–C8	1.7872 (12)		
Bond angle			
O1–S1–O2	118.46 (6)	Cl1–C3–C4	120.08 (9)
O1–S1–C8	107.63 (6)	Cl1–C3–C2	119.06 (10)
O1–S1–C9	107.95 (6)	N1–C7–C8	122.14 (11)
O2–S1–C8	108.57 (6)	N1–C7–C6	116.63 (11)
O2–S1–C9	108.17 (5)	S1–C8–C7	114.33 (8)
C8–S1–C9	105.32 (6)	S1–C9–C10	119.78 (9)
N2–N1–C7	120.74 (11)	S1–C9–C14	118.44 (9)
Torsion angle			
O1–S1–C8–C7	–175.58 (8)	C1–C2–C3–Cl1	178.98 (10)
O2–S1–C8–C7	55.07 (10)	N2–N1–C7–C6	178.36 (11)
C9–S1–C8–C7	–60.60 (10)	N2–N1–C7–C8	2.81 (18)
C8–S1–C9–C10	101.87 (11)	C6–C7–C8–S1	–87.39 (13)

TABLE 2: Hydrogen bond geometry ($\text{\AA}$, $^\circ$) of **5a**.

D–H...A	D–H	H...A	D...A	D–H...A
N2–H1...O2	0.847 (19)	2.413 (19)	3.0753 (15)	135.6 (17)
N2–H2...N1i	0.887 (18)	2.225 (19)	3.0383 (16)	152.4 (16)
N2–H1...O1ii	0.847 (19)	2.368 (19)	2.9687 (15)	128.3 (16)

Symmetry codes: (i) $-x + 1, -y + 1, -z + 1$; (ii) $-x + 1, -y, -z + 1$.

FIGURE 1: ORTEP diagram of **5a**, 40% probability ellipsoid, showing intramolecular hydrogen bond N2–H1...O2 (dashed line).

two parallel chains and forming a three-dimensional network (Figure 2). The selected geometric parameters and hydrogen bonds geometry for the crystal of **5a** were shown in Tables 1 and 2, respectively.

FIGURE 2: Portion of the crystal packing of **5a**. Dashed lines indicate N2–H2...N1 and N2–H1...O1 intermolecular hydrogen bonds. H atoms not involved in hydrogen bonding are omitted for clarity.

4. Conclusion

In conclusion, new series of oximes **4a–c**, hydrazones **5a**, **b**, and chalcones **7a–d** were prepared using MWI which is more efficient in the synthesis of these compounds with shortening the reaction time and increasing their yields. The X-ray analysis of **5a** gives the relative configuration for the 3D structure.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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